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Past Growth of
Yellow-Poplar and Oak Reproduction
Key to Future

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The Vinton Furnace Experimental Forest, where research described in this paper was done, is maintained by the Station in cooperation with the Mead Corporation of Chillicothe, Ohio.

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Past Growth of Yellow-Poplar and Oak Reproduction Key to Future

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Two years after clearcutting a hardwood stand on the Vinton Furnace Experimental Forest in southeastern Ohio we found abundant reproduction of desirable timber species. But we also found a dense tangle of vines, shrubs, and undesirable trees. The prospect that the desirable species would develop satisfactorily under this competition was uncertain, to say the least. If we could distinguish between seedlings of good and poor prospect, we could make a more reliable estimate of the future stand. Moreover, this would help us decide not only whether release is needed, but also which trees would respond best if released.

Therefore, in 1958 we began a study to find out how well the desirable reproduction would develop and whether release would be needed to bring more of it through this heavy competition. Also we wished to discover whether certain physical characteristics of yellow-poplar and oak seedlings are related to growth rate.

After 5 years most of the desirable trees that were dominant originally are still dominant and are growing even faster than the trees we released. The released trees are growing much faster than those needing release but not released and a number of the larger ones have remained free to grow. We also found that a seedling's past growth is a better indicator of its future growth than any other characteristic examined, and that release of very small trees is not effective.

The overstory on the area used for this study was a 90-year-old stand of black oak, chestnut oak, scarlet oak, white oak, and hickory with some yellow-poplar and northern red oak; the under-story included some shrubs and undesirable trees. Site index for

black oak ranges from 65 to 80. A 5-acre plot plus an isolation strip (a total area of 8.4 acres) was completely clearcut during the winter, spring, and early summer of 1953-54. Two years later, Merz and Boyce counted 6,340 yellow-poplars and 2,960 oaks per acre.¹ They estimated however, that at least three-fourths of the area was shaded by vines, shrubs, and undesirable trees. By early 1958 surviving yellow-poplar and oak seedlings and seedling sprouts averaged 3 feet in height and their average height growth the previous year was 1 foot and 1/2 foot, respectively. Undesirable species were not measured, but were generally taller, especially red maple and dogwood sprouts. In many places the canopy was 8 to 12 feet high.

What We Did

In the spring of 1958 (4 years after clearcutting) we selected 51 pairs of overtopped yellow-poplar seedlings and a total of 54 pairs of overtopped black, white, chestnut, northern red, and scarlet oak seedlings or seedling sprouts. Each pair consisted of two seedlings of about the same age and height, and each seedling was overtopped (as nearly as could be judged) by the same density of cover. One seedling of each pair was selected at random and released by removing all competing vegetation within 1 foot of the stem, and further by "nicking" and breaking down (without severing) any other vegetation that shaded the seedling. The other seedling was left to struggle along on its own. Because the treated trees did not respond well, we released them a second time the following summer. We also selected for study 40 yellow-poplars and 41 oaks that were judged free to grow (not overtopped), hence not needing release.

For each selected seedling, we determined the following physical characteristics: height-diameter ratio,² length of terminal bud, height growth of the previous season, and total height. These are characteristics found by Wenger³ to be highly correlated with height growth of loblolly pine seedlings.

¹Merz, Robert W., and Boyce, Stephen G. Reproduction of upland hardwoods in southeastern Ohio. U.S. Forest Serv. Cent. States Forest Expt. Sta. Tech. Paper 155, 24 pp., illus. 1958.

²The height-diameter ratio is an expression of seedling "stockiness" and is the ratio of the total height (to the base of the terminal bud on the central stem) to the diameter of the stem at a point halfway between the ground line and the bud.

³Wenger, Karl F. Height growth of loblolly pine seedlings in relation to seedling characteristics. Forest Sci. 1: 158-163. 1955.

What We Found

The seedlings originally selected as free to grow have each year grown significantly faster than those in need of release (whether released or not) (fig. 1). Not all these trees have remained dominant however. By 1962, after 5 growing seasons, 77 percent of the yellow-poplar and 30 percent of the oaks that were originally dominant are still free to grow (table 1). On the other hand, if we consider only those trees in the free-to-grow group that were at least as tall as the average of their age class, and whose growth during the previous year was average or greater, we find that 85 percent of the yellow-poplar and 67 percent of the oaks are still dominant 5 years later. This shows that the potential members of the future stand can be better identified by considering also the seedlings' height and their last year's height growth as well as their present crown position.

FIGURE 1.—Average total height of yellow-poplar and oaks.

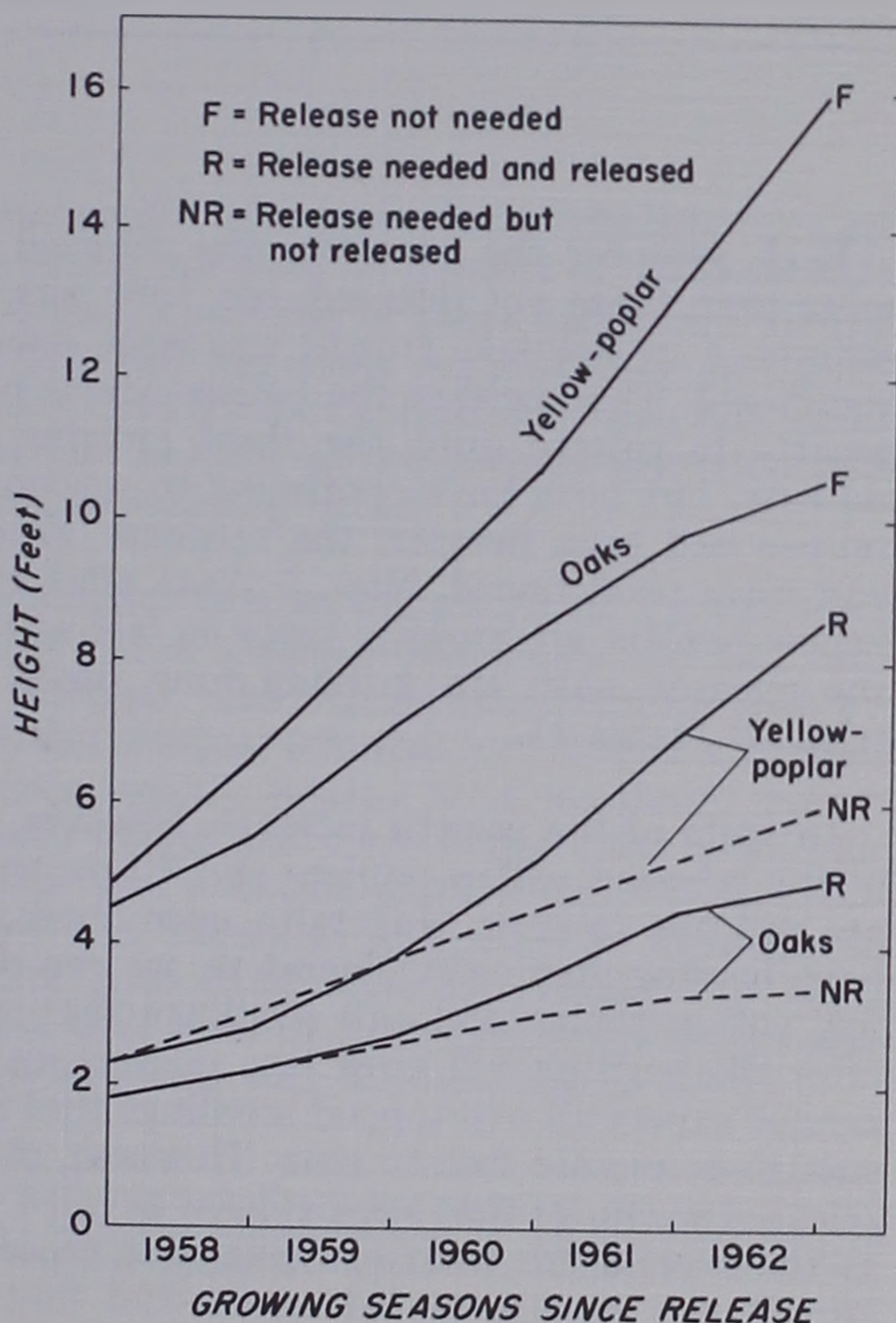


TABLE 1.— Crown position and growth of seedlings five growing seasons after treatment

Species	: Needed : release	: Released	: Trees free : to grow 5 : years later	: Average annual : height growth
			<u>Percent</u>	<u>Feet</u>
Yellow-poplar	No	No	77	2.6
	Yes	Yes	40	1.6
	Yes	No	14	.8
Oaks	No	No	30	.8
	Yes	Yes	10	.4
	Yes	No	6	.1

Each year for the past four the released seedlings have grown more than those not released, but 1960 was the first year that the difference in seasonal growth was large enough to be statistically significant. Thus neither the yellow-poplar nor the oaks responded greatly to release until the third growing season and after two releases, but both have continued to respond. Possibly if the first release had been heavier, the response would have been quicker and more pronounced. Now, 5 years after treatment, the released yellow-poplars are growing twice as fast as those not released, and the released oaks are growing four times as fast as those not released (table 1).

In spite of the growth increase, however, only about 40 percent of the released yellow-poplars and 10 percent of the released oaks are still free to grow. Naturally, even fewer of the unreleased trees have become dominant. Therefore, we can expect that only a very few yellow-poplar and oak seedlings that are overtopped 4 years after clearcutting will grow into dominance without help. And we cannot expect all overtopped seedlings that are released to respond enough to remain free to grow. However, if we consider only those released seedlings that were at least as tall 4 years after clearcutting as the average for their age class and those whose previous year's growth was average or better, we find that all are still dominant.

FIGURE 2. — Release of very small, slow-growing seedlings such as these proved useless.



The slow-growing trees continue to grow slowly whether released or not (fig. 2). After 5 years, less than 10 percent of the trees that needed release are dominant, and most of these had grown almost as fast as the average for their age class. Although the growth of those released was greater than those not released, these very small trees just did not grow fast enough to compete successfully with the rapid growth of the resprouting brush.

We found the best indicator of a seedling's future growth then to be its past height growth.⁴ A seedling that grows well one year will usually grow well the next. The other characteristics that we considered — height-diameter ratio, terminal bud length, and total height — seem to be only weakly related to a seedling's future growth. However, we also found that considering total height together with the previous year's height growth can increase the accuracy of identifying which seedlings are potential members of the future stand and are good candidates for release. The most promising are those trees that were at least average in height and whose height growth the previous year was average or better.

⁴The past year's height growth of yellow-poplar (always) and oaks (usually) can be distinguished quite easily as beginning at the ring of scars left by the previous season's terminal bud scales and by the color and texture of the bark. The newer bark is generally lighter in color and smoother in texture.

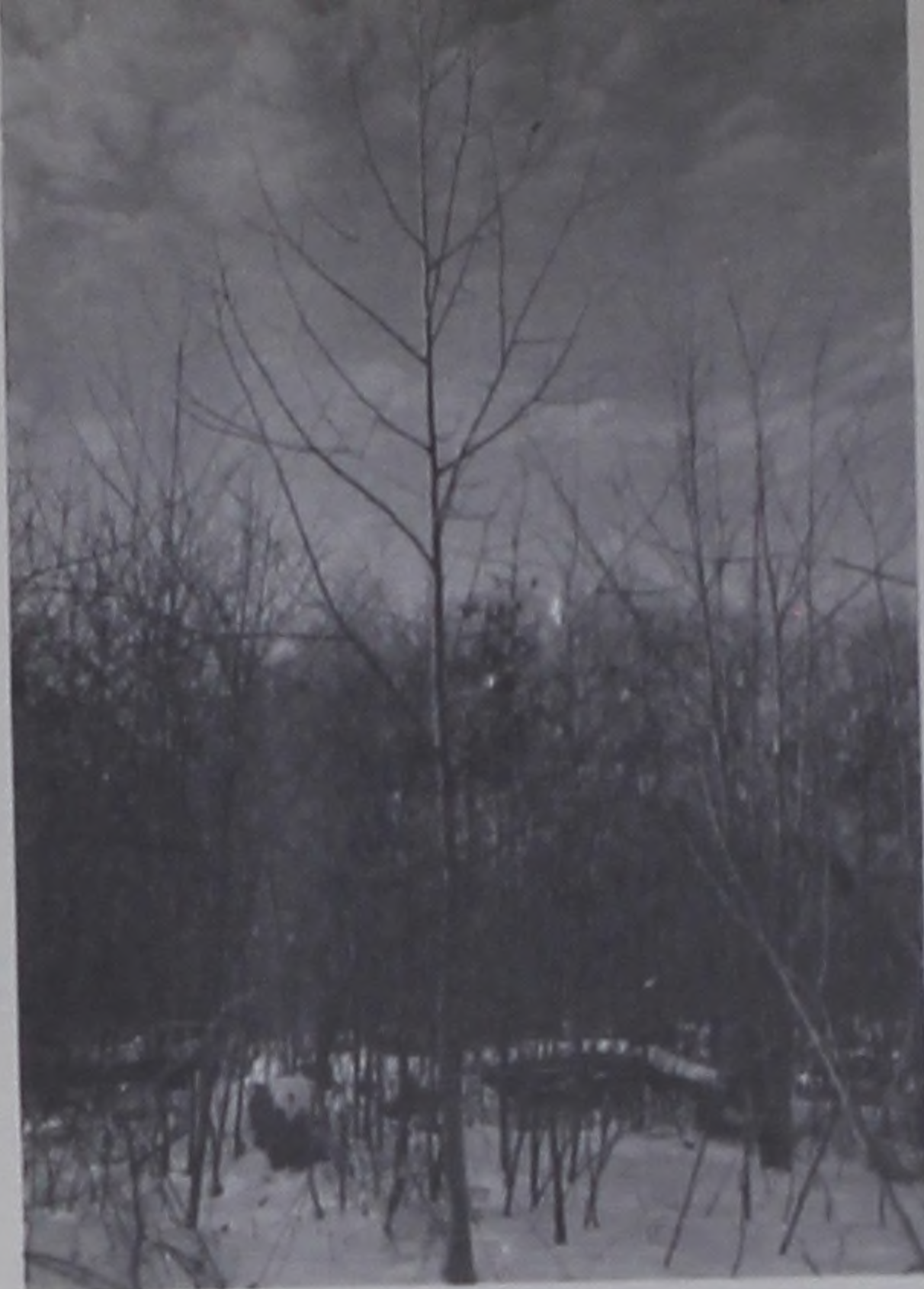


FIGURE 3. — This unreleased yellow-poplar seedling is 14 feet tall and free to grow 9 years after clearcutting.

Conclusion

The high percentage of originally dominant trees that are still dominant in this stand suggests that release was probably not necessary. For example, in a reproduction survey 7 years after clearcutting we counted an average of 540 yellow-poplar saplings per acre that were free to grow; these were on 21 percent of the milacre plots sampled (fig. 3). However, where there are too few dominant desirable seedlings in a young stand of upland hardwoods, species composition and distribution can be improved by cleaning. The trees selected for release should be only those overtopped or intermediates that are of average height or taller and whose previous year's growth was at least average for their age class.

Common and Scientific Names of Tree Species Mentioned

Dogwood	<i>Cornus florida</i> L.
Hickory	<i>Carya</i> Nutt.
Maple, red	<i>Acer rubrum</i> L.
Oak	
black	<i>Quercus velutina</i> Lam.
chestnut	<i>Q. prinus</i> L.
northern red	<i>Q. rubra</i> L.
scarlet	<i>Q. coccinea</i> Muenchh.
white	<i>Q. alba</i> L.
Pine, loblolly	<i>Pinus taeda</i> L.
Yellow-poplar	<i>Liriodendron tulipifera</i> L.

The Central States Forest Experiment Station is headquartered at Columbus, Ohio and maintains major field offices at:

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